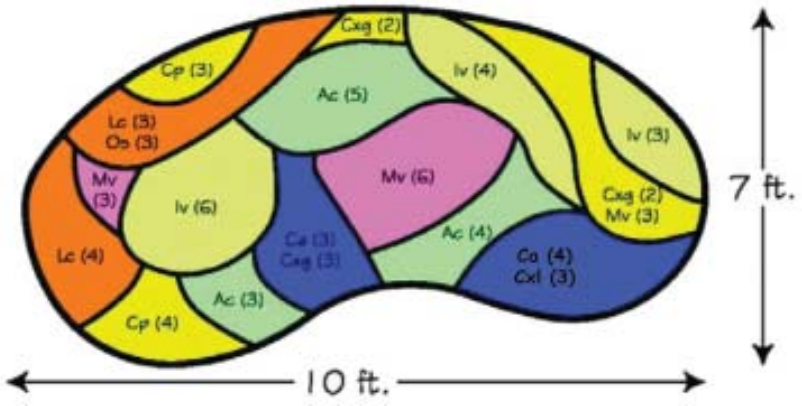
10 feet wide;
full to partial shade with clay soils

Total Area:
70 sq. ft.



Symbol	Scientific Name	Common Name	Number of plants
Ac	*Acorus calamus*	Sweet flag	5
Cp	*Caltha palustris*	Marsh marigold	7
Ca	*Campanuta americana*	Tall bellflower	6
Cxg	*Carex grayii*	Bur sedge	7
Cxl	*Carex lupulina*	Hop sedge	3
Iv	*Iris versicolor*	Blue flag	13
Lc	*Lobelia cardinalis*	Cardinal flower	7
Mv	*Mertensia virginica*	Virginia bluebells	25
Os	*Onoclea sensibilis*	Sensitive fern	2
		Total Plants Needed:	**70**

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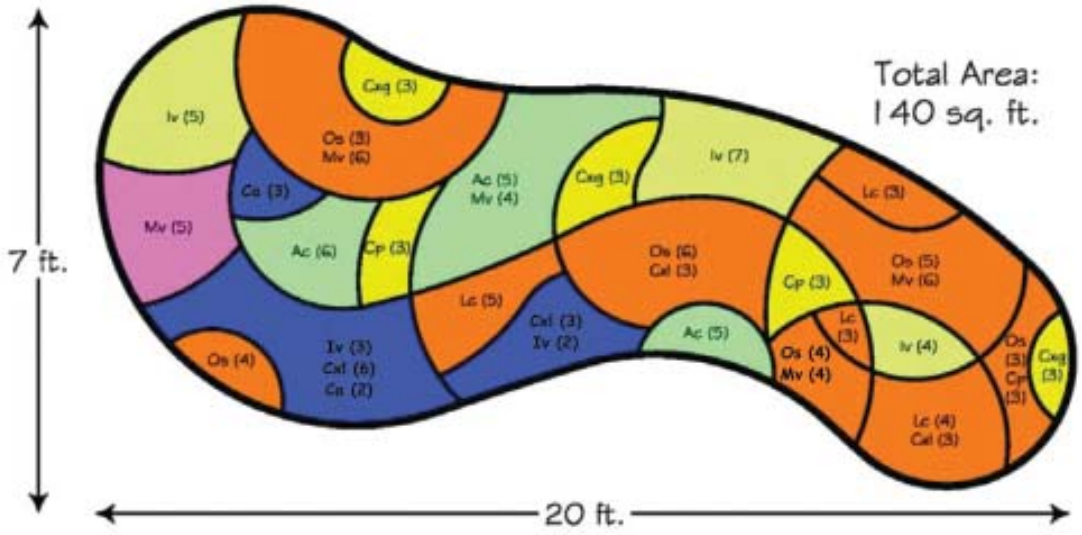
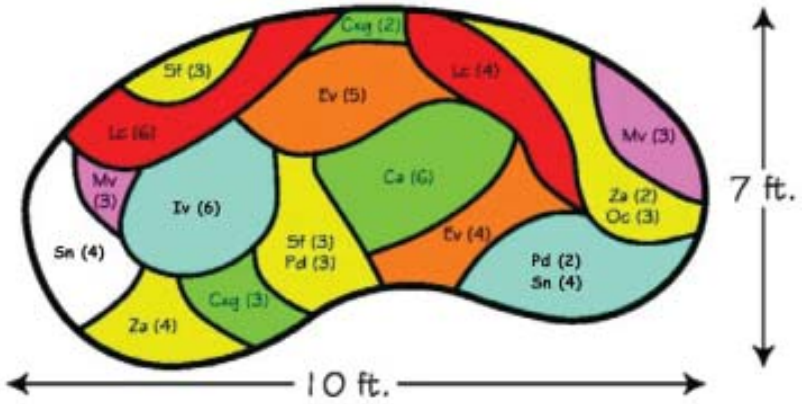
20 feet wide;
full to partial shade with clay soils



Symbol	Scientific Name	Common Name	Number of plants
Ac	*Acorus calamus*	Sweet flag	16
Cp	*Caltha palustris*	Marsh marigold	5
Ca	*Campanuta americana*	Tall bellflower	9
Cxg	*Carex grayii*	Bur sedge	9
Cxl	*Carex lupulina*	Hop sedge	15
Iv	*Iris versicolor*	Blue flag	121
Lc	*Lobelia cardinalis*	Cardinal flower	15
Mv	*Mertensia virginica*	Virginia bluebells	25
Os	*Onoclea sensibilis*	Sensitive fern	25
		Total Plants Needed:	**140**

10 feet wide;
full to partial shade with silt and sandy soils

Total Area:
70 sq. ft.



Symbol	Scientific Name	Common Name	Number of plants
Ca	*Campanuta americana*	Tall bellflower	6
Cxg	*Carex grayii*	Bur sedge	5
Ev	*Elymus virginicus*	Virginia wild rye	9
Iv	*Iris versicolor*	Blue flag	6
Lc	*Lobelia cardinalis*	Cardinal flower	10
Mv	*Mertensia virginica*	Virginia bluebells	6
Oc	*Osmunda claytoniana*	Interupted fern	3
Pd	*Phlox divaricata*	Wild blue phlox	5
Sf	*Solidago flexicaulis*	Zigzag goldenrod	6
Sn	*Symphyotrichum novi-belgii*	New York Aster	8
Za	*Zizia aurea*	Golden Alexander	6
		Total Plants Needed:	**70**

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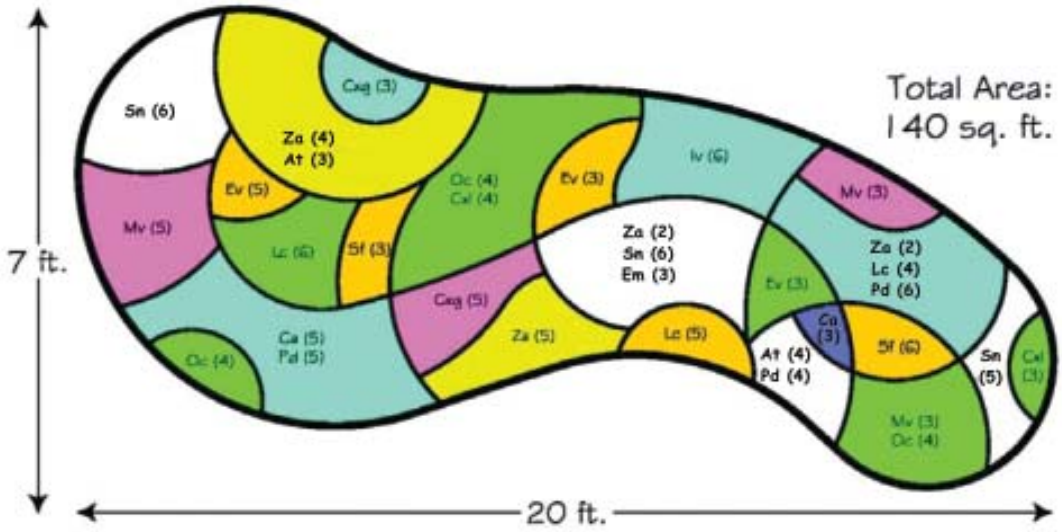
20 feet wide;
full to partial shade with silt and sandy soils



Symbol	Scientific Name	Common Name	Number of plants
At	*Arisaema triphyllum*	Jack-in-the-pulpit	7
Ca	*Campanula americana*	Tall bellflower	8
Cxg	*Carex grayii*	Bur sedge	8
Cxl	*Carex lupulina*	Hop sedge	7
Ev	*Elymus virginicus*	Virginia wild rye	11
Em	*Eupatorium maculatum*	Spotted joepyeweed	3
Iv	*Iris versicolor*	Blue flag	6
Lc	*Lobelia cardinalis*	Cardinal flower	15
Mv	*Mertensia virginica*	Virginia bluebells	11
Oc	*Osmunda claytoniana*	Interupted fern	12
Pd	*Phlox divericata*	Wild blue phlox	15
Sf	*Solidago flexicautis*	Zigzag goldenrod	9
Sn	*Symphyoctrichum novi-belgii*	New York Aster	17
Za	*Zizia aurea*	Golden Alexander	14
		Total Plants Needed:	**143**

List of Nurseries Providing Native Plants

The NPS does not necessarily endorse these nurseries.

(R) = Retail (W) = Wholesale

New Jersey

A Wild Bird Oasis (R)
741 Stokes Road
Medford, NJ 08055
PH: 609-654-6777
www.awildbirdoasis.com
Herbaceous & Woody

Arrowwood Nursery (R&W)
$ 3.00 catalog
870 W. Malaga Road, Rt 659
NJ
PH: 856-697-6045
Herbaceous & Woody Plants

Cicconi Farms (R&W)
1005 Farmingdale Road
Jackson, NJ 08527
PH: 732-363-1420
EMAIL: email@cicconifarms.com
Perennials,Grasses,ferns,herbs,
and Woody Plants

The Dawson Corporation (R&W)
Box 400
Clarksburg, NJ 08510
PH: 732-928-0600
FAX: 732-928-0660
EMAIL: tdcmls@optonline.net

Fairweather Gardens (R)
$ 2.00 Catalog (Mail order only)
PO Box 330
Greenwich, NJ 08323
PH: 609-451-6261
Woody Plants

Fernbrook Nursery, Inc. (W)
150 Georgetown Road, RT 545
PO Box 228
Bordentown, NJ 08505
PH: 609-298-8282
Woody & Perennials

Flora for Fauna Nursery (R)
Free Catalog
RR3 Box 438 Friedreichstadt Ave
Woodbine, NJ
PH: 609-861-0700
Herbaceous & Woody Plants

Mapleton Nurseries (W)
Mr. Bill Flemer
140 Mapleton Road
Kingston, NJ 08528
PH: 609-291-9486
www.mapletonnurseries.com
Herbaceous & Woody Plants – Mostly Woody

Ocean Wholesale Nursery (W)
705 Wright DeBow Road
Jackson, NJ
PH: 732-833-7000
EMAIL: Oceanwholesale@AOL.com

Pinelands Nursery (W)
$ 3.00 catalog
323 Island Road
Columbus, NJ 08022
PH: 609-291-9486
www.pinelandsnursery.com
EMAIL: sales@pinelandsnursery.com
Herbaceous & Woody Plants

Pleasant Run Nursery, Inc (W)
Heidi, Richard, & Louise
93 Ellisdale Road
PO Box 247
Allentown, NJ 08501
PH: 609-259-8585
www.pleasantrunnursery.com

Princeton Nurseries (W)
PO Box 185
Ellisdale Road
Allentown, NJ 08501
PH: 609-259-0492
TOLL FREE 1-800-916-1776
EMAIL: ADC@princetonurseries.com

Rare Find Nursery, Inc (R&W)
957 Patterson Road
Jackson, NJ 08527
PH: 732-833-0613
EMAIL: info@rarefindnursery.com

Toadshade Wildflower Farm (R)
Free catalog
53 Everittstown Road
Frenchtown, NJ 08825
PH: 908-996-7500
www.toadshade.com
EMAIL: toadshad@toadshade.com
Herbaceous Plants

Tuckahoe Nurseries, Inc. (W)
PO Box 576
Tuckahoe, NJ 08250
PH: 609-861-0533
EMAIL: tni@pro-usa.net

Pennsylvania

Aquascapes Unlimited (W)
PO Box 364
Pipersville, PA 18947
PH: 215-766-8151
Native Herbaceous Wetland Plants

Bowmans Hill Wildflower Preserve (R) No mail orders
PO Box 685
New Hope, PA 18938
PH: 215-862-2924
www.bhwp.org
EMAIL: bhwp@bhwp.org
Herbaceous & Woody Plants
Note: Has lecture/seminars every Sunday

Ernst Conservation Seeds (W)
9006 Mercer Pike
Meadville, PA 16335
TOLL FREE 1-800-873-3321
www.ernstseed.com

Octoraro Native Plant (W)
6126 Street Road
Kirkwood, PA 17536-9647
PH: 717-529-3160
www.Octoraro.com
EMAIL: octoraro@Octoraro.com

New Moon Nursery (W)
1492 Kirkwood Pike
Kirkwood, PA 17536
PH: 717-529-3870
www.NewMoonNursery.com
EMAIL: Info@newmoonnursery.com

Redbud Native Plant Nursery (R&W)
1214 N. Middletown Road
Glen Mills, PA 19342
PH: 610 358-4300
FAX: 610 358-3330

New York

Greenbelt Native Plant (W)
3808 Victory Blvd.
Staten Island, NY 10314
PH: 718-370-0932
Aquatic Plants, Ferns, Grasses, Salt Marsh Grasses, Herbaceous & Woody Plants

Wetland Plant Catalog (W)
2701 – A Route 305
PO Box 30
West Clarksville, NY 14786
PH: 716- 968-3120
www.southerntierconsulting.com
EMAIL: froghome@eznet.net

Talmage Farm (W)
2975 Sound Avenue
Riverhead, NY 11901-1114
PH: 631-727-0124
www.talmagefarm.com
EMAIL: info@talmagefarm.com

Maryland

The Perennial Farm
12017 Glen Arm Road
Glen Arm, Maryland 21057
PH: 410-592-6106
www.pernnialfarm.com
www.growingforyou.com
www.perennialavailability.com
EMAIL: info@perennialfarm.com

Virginia

Bobtown Nursery (W)
16212 Country Club Road
Melfa, VA 23410
PH: 757-787-8484
Natives, Ornamentals, & Wetland

Wisconsin

Prairie Nursey (W)
PO Box 306
Westfield ,WI 53964
TOLL FREE 1-800-476-9453
www.prairienursery.com
EMAIL: cs@prairienursery.com
Prairies, Woodlands, & Wetlands

Georgia

Classic Groundcovers, Inc. (W)
405 Belmont Road
Athens, Georgia 30605-4905
TOLL FREE 1-800-248-8424
www.classic-groundcovers.com

Native Plant List for New Jersey: A handful of species is adequate for a rain garden--this list is intended to give you flexibility in your plant selection.

Genus	species	Common Name	Type	Flower color	Sun/Shade	Wet Feet OK?	Wetland Indicator
Acorus	americanus	Sweetflag	herb	yellow	sun	yes	OBL
Andropogon	virginicus var. abbreviatus (A. glomeratus)	Bushy broomsedge	grass	none			FACW+
Aronia	prunifolia	Purple chokeberry	shrub	white	sun/shade	no	FACW
Asclepias	incarnata	Swamp milkweed	herb	rose-purple	sun	no	OBL
Aster	novae-angliae	New England Aster	herb	blue	sun/shade		FACW-
Aster	novi-belgii	New York aster	herb	violet-blue	sun		FACW+
Calamagrostis	canadensis	Bluejoint grass	grass	none		yes	FACW+
Caltha	palustris	Marsh marigold	herb	yellow		yes	OBL
Carex	crinita	Fringed sedge	herb		shade	yes	OBL
Carex	lurida	Shallow sedge	herb			yes	OBL
Cephalanthus	occidentalis	Buttonbush	shrub	white	sun	yes	OBL
Chelone	glabra	Turtlehead	herb	white	sun		OBL
Clethra	alnifolia	Sweet pepperbush	shrub	white	shade	no	FAC+
Cornus	amomum	Silky dogwood	shrub	white	sun	no	FACW
Elymus	virginicus	Virginia Wild Rye	grass	none			FACW-
Eupatorium	maculatum	Spotted Joe-pye Weed	herb	pink	sun	no	FACW
Eupatorium	perfoliatum	Boneset	herb	white	sun	no	FACW+
Gentiana	clausa	Bottle gentian	herb	blue-purple	sun		FACW
Gerardia	purpurea	Purple gerardia	herb	purple	sun		
Glyceria	canadensis	Rattlesnake grass	grass	none		yes	OBL
Helianthus	giganteus	Swamp sunflower	herb	yellow			FACW
Helinium	autumnale	Sneezeweed	herb	yellow	sun		FACW+
Hibiscus	moscheutos	Swamp rose-mallow	herb	pink, white	sun, shade	yes	OBL
Ilex	verticillata	Winterberry	shrub	white	sun-shade	yes	FACW+
Impatiens	biflora	Jewelweed	herb	orange	sun		
Iris	versicolor	Blueflag iris	herb	purple	sun, shade	yes	OBL
Itea	virginica	Virginia sweetspire	shrub	white			OBL
Juncus	effusus	Soft rush	herb			yes	FACW+
Leersia	oryzoides	Rice cutgrass	grass	none	sun	yes	OBL
Lobelia	cardinalis	Cardinal flower	herb	red	sun		FACW+
Lobelia	siphilitica	Blue lobelia	herb	blue	sun	no	FACW

+

Genus	species	Common Name	Type	Flower color	Sun/Shade	Wet Feet OK?	Wetland Indicator
Lysimachia	ciliata	Fringed loosestrife	herb	yellow	sun		
Matteuccia	struthiopteris	Ostrich fern	fern		shade		FACW
Mertensia	virginica	Virginia bluebells	herb		shade		
Mimulus	ringens	Monkey flower	herb	blue	sun		OBL
Monarda	didyma	Bee balm	herb	red	sun		
Onoclea	sensibilis	Sensitive fern	fern		shade		FACW
Osmunda	regalis	Royal fern	fern				OBL
Panicum	virgatum	Switchgrass	grass		sun		FAC
Phlox	pilosa	Prairie phlox	herb				
Pycnanthenum	virginiana	Mountain mint	herb		sun		
Rhexia	virginica	Meadow beauty	herb	pink	sun		OBL
Rosa	palustris	Swamp rose	shrub	pink	sun	yes	OBL
Sagittaria	latifolia	Duck potato	herb	white	sun		OBL
Saururus	cernuus	Lizard tail	herb	white			OBL
Scirpus	cyperinus	Woolgrass	sedge			yes	FACW+
Scirpus	pungens	Common threesquare	sedge			yes	FACW+
Scirpus	tabernaemontanii	Softstem bulrush	sedge			yes	OBL
Senecio	aureus	Golden ragwort	herb	yellow	sun		FACW
Sparganium	americanum	Lesser bur-reed	herb		sun	yes	OBL
Spirea	tomentosa	Steeplebush, Hardhack	shrub	pink	sun		FACW
Spirea	alba var. latifolia	Meadowsweet	shrub	white			FAC+
Thalictrum	dasycarpum	Tall meadow rue	herb	white	sun		FACW+
Thelypteris	palustris	Marsh fern	fern		sun-shade		FACW+
Vaccinium	corymbosum	Highbush blueberry	shrub	white	sun-shade		FACW-
Vernonia	noveboracensis	NY Ironweed	herb	magenta	sun		FACW+
Verbena	hastata	Blue vervain	herb	blue	sun	no	FACW+
Viburnum	dentatum	Northern arrowwood	shrub	white	sun-shade	no	FAC
Viburnum	trilobum	American cranberrybush	shrub	white	sun-shade		FACW
Viola	conspersa	American dog violet	herb	blue	sun, part shade	no	FACW
Zizia	aurea	Golden alexander	herb	yellow	sun		

Assistance and Funding Available for Teachers

In 2004 NPSNJ began working together with representatives from Project WILD (Sponsored by New Jersey Department of Environmental Protection, Division of Fish and Wildlife). Natural Resources Conservation Service (NRCS) and the NJ DEP Division of Fish and Wildlife have teamed up to bring wildlife habitat to students in New Jersey by using the Wildlife Habitat Incentives Program (WHIP) and WILD School Sites.

WHIP, an NRCS program, provides technical and financial assistance to create, enhance, or maintain habitat to be used as outdoor classrooms on school grounds and at environmental education centers. Funds can be used to plant native trees, shrubs, and grasses, and also to establish wetlands and native meadows. WHIP can provide up to 75% cost sharing to implement projects. On most WILD School sites WHIP provides about $2000-$3000, and the school and other partners provide the remaining 25% of the project cost.

As a condition of participation in WHIP, at least one teacher from each school or education center must complete NJ DEP Division of Fish and Wildlife's WILD School Site training. At the workshop, teachers learn about wildlife needs, which plants provide the best wildlife habitat, how to inventory a potential WILD School site, how to prepare wildlife habitat development plans, and how to involve students in the development and implementation of the plan. The workshops equip teachers with all of the resources they need to design an outdoor classroom and to incorporate it into lesson plans. Participating teachers receive 5 to 6 Professional Development Credits.

For more information go to the following websites:

http://www.nj.gov/dep/seeds/bo/bofall03.htm#wild

"Captain Planet Foundation"

http://www.captainplanetfdn.org/aboutUs.html#policies_grant_guidelines

LESSON 1: Mini Brilliant Ideas (MBI)

These ideas are short and quick. Teachers can use these as introductory activities, closure activities, or fillers. They must be educational and connected to the big picture, and are fun. This is also known as *Learning on the Run*.

MBI # 1 Odes
An ode is a poem about something that you like. Your ode is a mini advertisement that illustrates the virtues of the object under study. Try an *Ode to Rain Gardens, Ode to Native Plants*, or an ode to any part of a rain garden. Students can choose to rhyme in any pattern they wish, or have no rhyme at all. Sharing odes is fun. Some unedited first draft student odes are included as samples.

MBI # 2 How can you figure out how many plants you need for a given area (a plant layout)?
Example: If you have 86 square feet and plan to plant seedlings at 1.5 foot on center, how many do you need? The formula for figuring this out is to divide the area by the spacing squared. In this example, it is 86 divided by 2.25 (1.5 squared) = 38.2 plants

MBI # 3 How can you measure the infiltration rate of your potential rain garden?
Take a large juice or coffee can that has had both the top and bottom taken off. Wedge it an inch or two into the soil of your potential rain garden to prevent water from leaking out. Pour a gallon of water into the can. (If it doesn't all fit, pour the rest in as the drains into the soil. Measure the time it takes for that water to disappear. That is your infiltration rate. If the soil is clay, it may take hours. You want the soil to drain well.

LESSON 2: Overview of Glyphs

Glyphs are a pictorial display of data. They can be used for a variety of purposes. You can introduce a concept, work on vocabulary, or assess student knowledge with glyphs.

This activity builds an awareness of plant parts and the variety each part can have. It begins building a common class vocabulary of plants. In addition, it demonstrates to students the translation of information from words to pictures.

Format for Lesson: Plant Glyph

Summary: This activity has students display information about themselves that serves as an introduction to some plant vocabulary. This may be used as an icebreaker activity in your class.

Students will:
- be able to identify various structures of a plant
- be able to practice taxonomic classification
- be able to begin to generate a baseline vocabulary for beginning a unit on plants

Materials:
- Glyph Key – You can have one key per student, copying on the back to save paper. You could also have the key as a transparency or one on display to save paper and ink.
- Plant Glyph page
- Pencils or pens for drawing
- Colored pencils or crayons for coloring
- Tape

Background:
- Egyptians used hieroglyphics as a communication tool. Each picture was a symbol which could be read by others. Students will use a key to create their own glyph and read the glyphs of other students. This is visual representation of data. It can be noted that it takes less time to read a glyph than a worded paragraph.

Procedure:
- Ask students if they have ever heard the word glyph before.
- Draw from them that they have heard it as part o f a word-hieroglyphics.
- Then ask students what hieroglyphics are.
- Distribute the Plant Glyph page.
- Have students fill in the list on the left.
- Discuss the Glyph Key.
- Beginning with roots, have students draw the root that matches their response to Pets.
- Discuss the difference between taproot and fibrous root.
- Go one by one with all the other categories listed.
- Make sure students don't put their names on their glyphs as the point of the activity is to have other interpret the glyph and find the student. (interpreting the data).
- When completed, tape students' glyphs on the wall. Discuss classification. Allow students to suggest categories, i.e. male/female, no siblings/siblings, birthday months, etc. Move glyphs into suggested categories.

Assessment
- Observe students as they interact and check for their understanding

Extension
- This activity can begin an exploration of categories of leaf shape, margin, vein patterns, roots, etc.
- Have students create another glyph using the characteristics of flowers, buds, monocots vs dicots, indigenous vs non indigenous plants, etc.
- Make an Excel Graph using the data from just the glyphs.
- Before hanging glyphs, have the students cut off the left half so that no words are hung.
- Glyphs are a great Back-to-School night activity. Students can create a glyph which is put on their desk. When parents enter the room, they must find their child's desk using the glyph key.

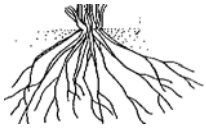
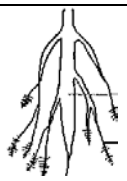
Glyphs: Standards

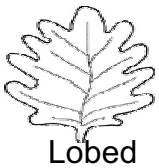
Standard 4.4 (Data Analysis, Probability, and Discrete Mathematics)
All students will develop an understanding of the concepts and techniques of data analysis, probability, and discrete mathematics, and will use them to model situations, solve problems, and analyze and draw appropriate inferences from data.
A. Data Analysis

Standard 5.5 Characteristics of Life
B. Diversity and Biological Evolution

Glyphs: Hand Out 1

On the right side of the other page, draw your own customized plant that matches your own information using the key below. The wavy line represents the ground. Your roots go below the line, and the rest of the plant is above the line.

ROOT - Pets	
 Fibrous Root	You have pets
 Tap Root	You have NO pets

LEAVES	
 Lobed	Male
 Elliptical	Female

COLORS	
Leaves	Color the leaves the color of your hair.
Flowers	Color the flowers (or berry) the color of your eyes.

NUMBER OF LEAVES
Month you were born in. (Example – January, one leaf, August 8 leaves)

CREATURES	
Draw any type of creatures you wish….The number must match your siblings.	
# of Creatures Underground	Number of Brothers You Have
# of Creatures Above the Ground	Number of Sisters You Have

FLOWERS
Create any shape flower you wish.
Make the number of flowers the same as the number of siblings you have. If you have no siblings, draw a large berry.

Glyphs: Handout 2

Data Collection

Circle one answer for each question below.

- Do you have any pets? Yes No
- Do you have siblings? Yes No
- What is your gender? Male Female

Answer these questions.

- What color is your hair? _____
- What color are your eyes? _____
- How many brothers do you have? _____
- How many sisters do you have? _____
- What is the number of the month you were born in? _____

LESSON 3: Conflict Resolution Problems For Rain Gardens

Coloring is a challenging and enjoyable part of discrete math. There are two introductory lessons in coloring and three conflict resolution coloring problems. The NJ Counties Map introduces the process of vertex coloring, and the Lake Topanemus problem gives the students practice in coloring an actual vertex problem. The other two problems use this knowledge of vertex problems to explore soil additives and plants for your rain garden.

Coloring Introduction

Two worksheets are provided as introduction, reprinted with permission from the Rutgers Leadership Program in Discrete Mathematics.

- You can choose to do both coloring exercises, one, or none.
- NJ Counties Map –The rule is that no two areas which share a border can be the same color.
- Graph Coloring – Introduces graphs (created using vertices - singular is vertex - and connecting edges) The rule is that no two vertices can be the same color as others it is connected to with an edge.
- Rules for BOTH Map and Vertex coloring – Use as few colors as possible… Less is Best!

Conflict Resolution Problems

1. Summary: Students will use conflict resolution activities as a vehicle for learning more about requirements for their rain garden.

2. Students will:
    - Be able to improve their visualization of patterns when planning map coloring
    - be able to translate conflict situations into a vertex coloring problem
    - be able to practice open-ended problems with several solutions and explain and defend their answer
    -
3. Materials
    - NJ Counties Map handout, if desired
    - One or more of the conflict resolution worksheets – New Jersey Native Plant Plot Decisions, Barkalow School Service Learning Garden Experiments, and Lake Topanemus Biological Monitoring Problem
    - Colored pencils or crayons

4. Background

You can choose to use this activity to springboard research about your area's native plants, and water monitoring with your class. Begin research on native plants using the ones listed on these activies, then challenge students to find which native plants are available in and appropriate to your particular region, sun, soil, and water condition. This activity can spark a great environmental discussion among students.

- The idea of map coloring is that no two sections which touch can be the same color. This practice makes sure that neighboring areas don't appear combined.
- The challenge is to use the fewest colors possible. This practice saves money when printed with a charge per color, and hones higher-level thinking skills.

5. Procedure
   - Discuss the big idea about which one(s) you will be using in class – Native plants, stream macroinvertebrate environments, and/or experiment design for service learning garden.
   - Distribute the worksheets and read the problem aloud. Tell students that they are being asked to find a solution for this problem.
   - Ask students to take some colored pencils/crayons to find a solution.
   - OPTIONAL - While students are engaged in thinking, and have not yet begun to color, suggest they use manipulatives (aka M&Ms or Skittles) to perform trial and error with coloring. When they have decided on a solution they like, they should color the verticies.
   - When all students have reached a solution, have them compare their choices, and stand in groups with others who have chosen to plant the same plants in the same plots. Discuss choices with the class. This is always a dynamic cooperative activity as students compare the size of each group, and listen to each others' reasoning for their choices.

6. Assessment
   - Watch students as they interact and check for their understanding

7. Extension
   - Students can make graphs using vertices and edges for others to solve.

   Students can create conflict resolution situations into a problem to solve

Barkalow Garden Problem: Standards

Standard 4.4 (Data Analysis, Probability, and Discrete Mathematics)
All students will develop an understanding of the concepts and techniques of data analysis, probability, and discrete mathematics, and will use them to model situations, solve problems, and analyze and draw appropriate inferences from data.
Discrete Mathematics-Vertex-Edge Graphs and Algorithms. Vertex-edge graphs, consisting of dots (vertices) and lines joining them (edges), can be used to represent and solve problems based on real-world situations. Students should learn to follow and devise lists of instructions, called "algorithms," and use algorithmic thinking to find the best solution to problems like those involving vertex-edge graphs, but also to solve other problems.

STANDARD 5.1 (SCIENTIFIC PROCESSES)
Habits of Mind
A. Inquiry and Problem Solving
B. **Safety**

Standard 5.3 (Mathematical Applications)
All students will integrate mathematics as a tool for problem-solving in science, and as a means of expressing and/or modeling scientific theories.

Standard 5.5 Characteristics of Life

B. Diversity and Biological Evolution

Reproduction and Heredity

Standard 5.10 Environmental Studies

A. Natural Systems and Interactions
B. Human Interactions and Impact

Standard 9.1 - Career and Technical Education

A. Career Awareness and Planning
   7. Plan and conduct a cooperative project that addresses one of the problems faced by the school and/or community.
B. Employability
   1. Describe and demonstrate the importance of personal and interpersonal skills.
   2. Identify positive work habits and attitudes necessary for home, community, and school.
   3. Identify reasons for working as part of a team.

Lake Topanemus Problem Standards

If the students use the problem as an activity in discrete mathematics, these standards apply:

Standard 4.4 (Data Analysis, Probability, and Discrete Mathematics)
All students will develop an understanding of the concepts and techniques of data analysis, probability, and discrete mathematics, and will use them to model situations, solve problems, and analyze and draw appropriate inferences from data.
Discrete Mathematics-Vertex-Edge Graphs and Algorithms. Vertex-edge graphs, consisting of dots (vertices) and lines joining them (edges), can be used to represent and solve problems based on real-world situations. Students should learn to follow and devise lists of instructions, called "algorithms," and use algorithmic thinking to find the best solution to problems like those involving vertex-edge graphs, but also to solve other problems.

Standard 5.3 (Mathematical Applications)
All students will integrate mathematics as a tool for problem-solving in science, and as a means of expressing and/or modeling scientific theories.

Standard 5.5 Characteristics of Life

C. Diversity and Biological Evolution

Reproduction and Heredity

If your class uses the extra credit extension and investigates “macroinvertebrates,” the following science standards also apply:

Standard 5.10 Environmental Studies

C. Natural Systems and Interactions
D. Human Interactions and Impact

Barkalow Garden Problem: Hand Out

BARKALOW SCHOOL
SERVICE LEARNING GARDEN EXPERIMENTS

	Worm Compost	**L**unchroom Compost	**H**orse Manure	**R**ye - Winter Cover Crop	**P**owdered Sea Kelp	**S**hredded Paper
Worm Compost	-	-	X	-	X	-
Lunchroom Compost	-	-	-	X	-	X
Horse Manure	X	-	-	X	X	X
Rye - Winter Cover Crop	-	X	X	-	X	X
Powdered Sea Kelp	X	-	X	X	-	X
Shredded Paper	-	X	X	X	X	-

A service-learning project is part of the curriculum in Ms Eisemann's class. Students design and carry out vegetable experiments with watershed-friendly soil additives as alternatives to chemical fertilizers. The vegetables that result from these experiments are delivered weekly in the summer to local food pantries.

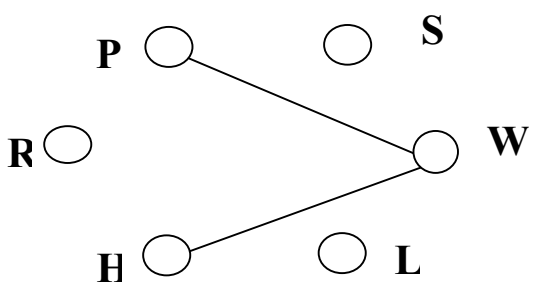
Each vertex represents an additive using its first initial. The combinations of additives overlap between experiments. Connect each vertex below to all in the table that have a conflict (shown as an X) with a pencil or pen. Worm Compost has been connected and checked off for you as an example. Then color the vertices so that no two vertices have the same color when shared by an edge (line). How many different plots will the class have to divide the garden into so that all students' experiment designs will work?

EXTRA CREDIT – 1. How many different solutions can you find?

2. Choose one additive from the table, and research it on a search engine. Write your findings on the back of this paper.

Keep in mind that you are connecting conflicts in this graph. Therefore you need to color (solve) so that no two vertices are the same color that are connected by a line (edge).

NOTE: Check with the newspapers you are using to be sure the ink they use is soy-based. *Shredded newspaper may be ontaminated withcadmium and other chemicals if any colored sections are used. Use with caution.*



Lake Topanemus: Hand Out

	Stone fly Nymphs	**D**ragonfly Nymphs	**W**ater Penny Larvae	**C**addisfly Larvae	**R**iffle Beetle Larvae	**A**quatic Worms
Stonefly Nymphs	-	X	X	X	-	-
Dragonfly Nymphs	X	-	X	-	X	X
Water Penny Larvae	X	X	-	-	X	X
Caddisfly Larvae	X	-	-	-	X	-
Riffle Beetle Larvae	-	X	X	X	-	X
Aquatic Worms	-	X	X	-	X	-

LAKE TOPANEMUS BIOLOGICAL MONITORING PROBLEM

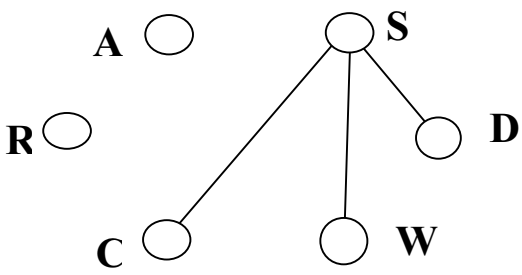
Ms Eisemann's class is monitoring the health of the water at Lake Topanemus with biological monitoring using macroinvertebrates. Students have been researching the habitats of several species. From their research, they have created the above table showing which species may be found in similar habitats. They look forward to further research and discovery from their explorations. This table will evolve from their findings as time goes on.

Each vertex below represents a macroinvertebrate using its first initial. Connect each vertex below to all in the table that have a conflict (shown as an X) with a pencil or pen. Stoneflies has been connected and checked off for you as an example. Then color the vertices so that no two vertices have the same color when shared by an edge (line). There are four general areas that stream samples can be taken from. From your graph solution, do you think that the Watershed Ambassadors sampled all four areas of the stream off of the lake? (In other words, are four colors the fewest amount of colors you can use?) Be ready to defend your answer.

EXTRA CREDIT –

1. How many different solutions can you find?
1. Go to a search engine and type in "benthic macroinvertebrates." Research each creature and see what makes it compatible or incompatible with another. What environment might each creature need? Can any be in more than one environment? Write your findings on the back of this paper.

Keep in mind that you are connecting conflicts in this graph. Therefore you need to color (solve) so that no two vertices are the same color that are connected by a line (edge).



LESSON 4: ID Wheel

This plant ID Wheel serves several purposes. The blank wheels can be customized to your garden. When students enter plant information by hand, it is more memorable to them. If they research information, this gives them more choices. After information is filled in, students can practice matching all characteristics of plants and see that there are several choices for each category. This drives home that planning a garden is open-ended; there is no one correct answer. In addition, a student-designed wheel will hold far more credence with other students than a pre-conceived wheel that one has to memorize.

Format for Lesson ID Wheel

Summary: This activity leads students to compare and contrast plants in several categories for the purpose of designing a garden.

Students will:

be able to identify several native plants that would be successful in a rain garden
be able to practice classification
be able to begin to generate a baseline knowledge of plants which may be included your rain garden to create the best design

Materials

Paper for copying circles – cardstock or tag board are more durable than copy paper
Scissors
Pencils, pens, thin markers for writing
Brass fastener for holding it all together
Push pin or other implement for making center holes to assemble.

Background

This activity familiarizes students and you with the characteristics of the plants you are considering for your rain garden. It categorizes plant information into light requirements, flower color, blooming time, height, wildlife role (food, shelter), etc.

This can be done at a variety of places in your project. Before beginning, you may wish to have students research plants native to your area that would be successful in a rain garden. They can choose which to include on the ID Wheel. Or they can use the chart provided to put information in the wheels.

You could use this as a starting point to gather information that will help you make plant choices.

The activity promotes knowledge of plants and comparison of characteristics to help you make the best-informed decision for optimum rain garden design for your purposes.

Procedure

Distribute ID Wheels to students. You may wish to have one set per student, one per pair, or one per group.

Discuss categories of individual plants: Plant botanical and common name, light requirement, height, flower color, blooming season, wildlife role (food, shelter), etc.

Students can use plants from the included table or research their own, according to your assignment. There is room for 8 plants. These blank wheels allow for customization and different ways of seeing things.

Direct students to cut out the three wheels and make a hole at the center of the three circles with a push pin or similar object and assemble wheels with the smallest one on top.

Keeping in mind that the 3 wheels are available for three combined characteristics of plants, students can fill them in. Their writing can be in any direction. It would be helpful if students complete a table for their chosen plants in the categories. This can serve as the answer key for their wheel.

There are three wheels. The chart shows the information paired below. Students can add other categories and combine them in different ways.

Botanical and common name of plant - A sketch of the plant and/or flower would be helpful.
Light requirement and height
Flower color and blooming season

Allowing students to choose which wheel should include which categories allows creativity and individual choice. It puts ownership on student creators.
Students can choose to keep all wheels in the same order, so when one plant is lined up all plants are correctly lined up. Or they may choose to scramble the order in each wheel so answers don't necessarily match.

Assessment

Observe students as they create their table, including research if applicable.
Notice the creative approach taken by individual students as they plan their wheel.
Have students exchange wheels and try out others. An answer key, in the form of a table or otherwise, is important.

Extension

Students can create multiple wheels for more garden choices. They could make one for low-growing plants, one for medium-growing plants, and one for higher plants, or one for shade, one for sun, and one for partial sun. This would demonstrate a variety of choices for your individual situation.
From the information the wheels give, students can design a designated-size garden according to the information given. This is a good opportunity for them to see that the garden blueprint is open-ended, and many designs can be achieved using height, color, etc.
Students can create other gardens – wetlands, vegetable, etc. – filling in these ID Wheels.

Plant ID Wheel: Standards

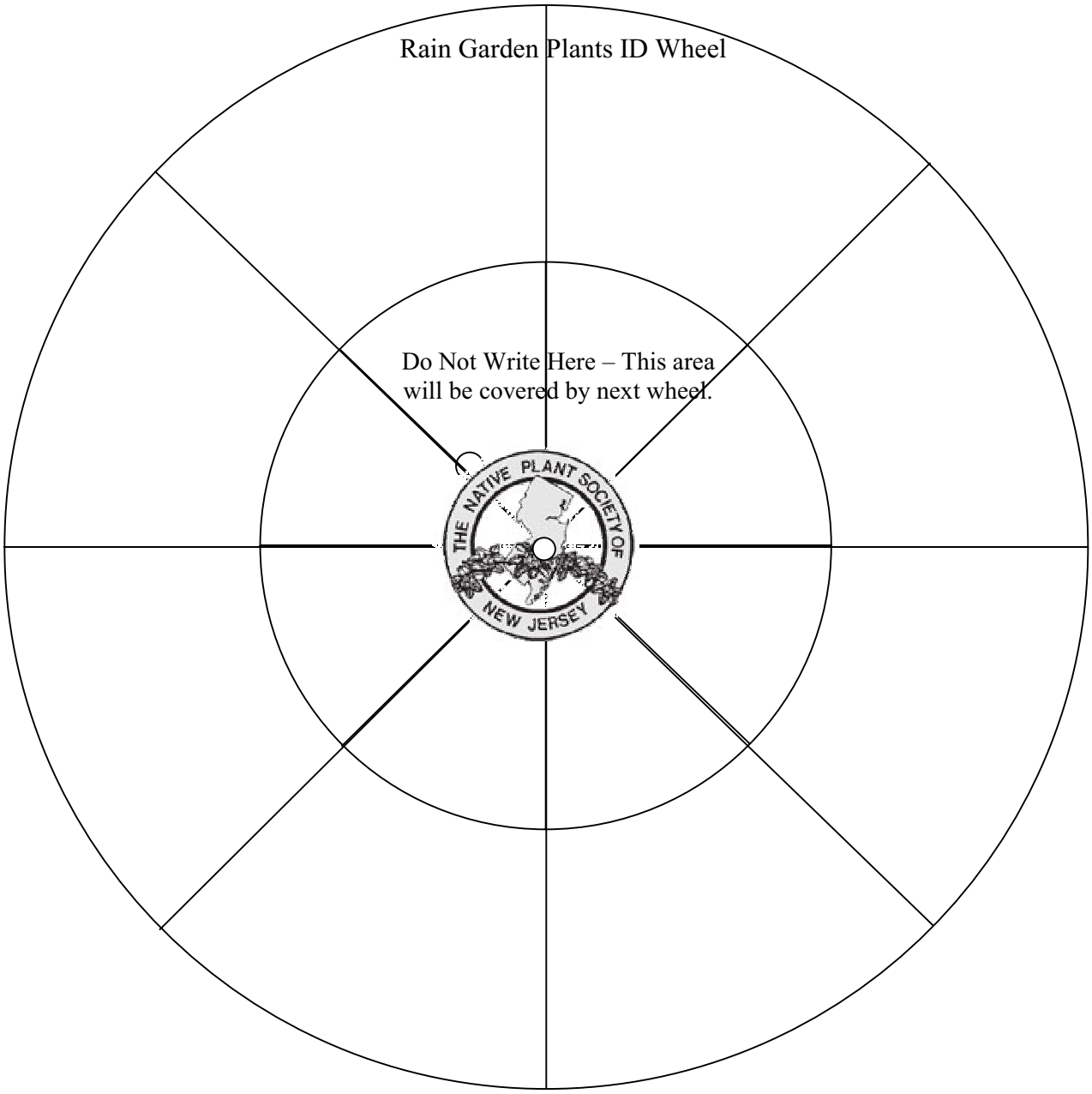
Standard 4.3 (Patterns and Algebra)
All students will represent and analyze relationships among variable quantities and solve problems involving patterns, functions, and algebraic concepts and processes.

Standard 5.3 (Mathematical Applications)
All students will integrate mathematics as a tool for problem-solving in science, and as a means of expressing and/or modeling scientific theories.

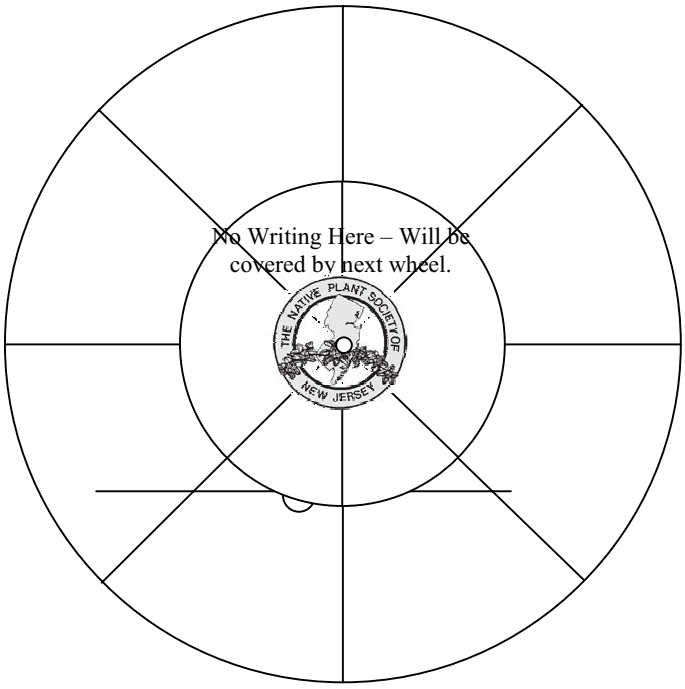
Standard 5.5 Characteristics of Life
Diversity and Biological Evolution
Reproduction and Heredity

Standard 5.10 Environmental Studies
Natural Systems and Interactions

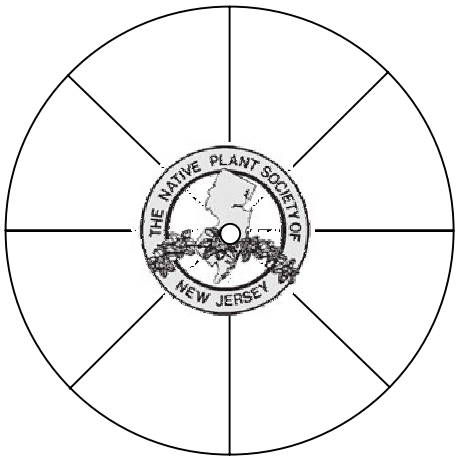
ID Wheel: Handout



ID Wheel: Hand Out



Other categories can be added such as drawing of flower, wildlife it attracts, etc. Be creative.



You can show flower color with a scribble of color pencil or crayon, or write the word.

ID Wheel: Hand Out

Sample Plant ID Wheel Table for Rain Garden Plants		
Botanical and Common Plant Name	**Light Requirement And Height**	**Flower Color and Blooming Season**
Lobelia cardinalis Red Cardinal Flower	Full Sun 2-3 feet	Red July-September
Acorus Species Sweet Flag	Full Sun 3-6 feet	Yellow July-August
Asclepias incarnate Swamp Milkweed	Full Sun 3-4 feet	Rose-purple August
Epatorium purpureum Green-stemmed Joe-pye Weed	Sun/Part Shade 4-6 feet	Rosy-purple August-September
Iris versicolor Blue Flag Iris	Full Sun 2-3 feet	Purple June-July
Ligularia species Goden Ray	Part Shade 1 foot	Golden Yellow July-September
Viola cucullata Blue Marsh Flower	Sun/Part Shade 6 – 10 inches	Purple, White May
* *Lysimachia ciliate* Fringed Loostrife	Full Sun 2-4 feet	Yellow May

Native Plants of New Jersey

Monarda fistulosa
Wild Bergamot

Onoclea sensibilis
Sensitive Fern

Osmunda claytoniana
Interrrupted Fern

Phlox stolonifera
Creeping Phlox

Polemonium repans
Greek Valerian

Polygonatum canaliculatum
Great Solomon's Seal

Polystichum acrostichoides
Christmas Fern

Pycnanthemum sp.
Mountian Mint

Rubus odoratus
Flowering Raspberry

Rudbeckia hirta
Black Eyed Susan

Solidago sp.
Goldenrod

Tiarellia cordifolia
Foam Flower

Veronicastrum virginicum
Culver's Root

Viola sp.
Violet

Zizia aurea
Golden Alexanders